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(54) Title: METHOD AND MEANS FOR CONTROL OF RADIATED ENERGY

(57) Abstract: The present invention relates to a method and a membrane for regulating albedo in an upper layer of a solid surface on the earth in order to influence thermal and biological factors such as surface temperature and cultivation properties. To the surface a liquid is applied which sets to form a biodegradable membrane, and the membrane's content of light-reflecting and/or light-absorbing particles/pigments is adjusted on the basis of the maximum energy radiation which is conveyed to an upper layer of a solid surface on the earth based on measurements of the local conditions.

METHOD AND MEANS FOR CONTROL OF RADIATED ENERGY.

The present invention relates to a method for regulating albedo in an upper layer of a solid surface on the earth in order to influence thermal and biological factors such as surface temperature and cultivation properties, there being applied to the surface a liquid which sets to form a biodegradable membrane. The membrane's content of light-reflecting pigments/particles and/or light-absorbing pigments/particles is adjusted on the basis of the maximum energy radiation which is conveyed to the solid surface on the earth to which the liquid is applied, based on measurements of the local conditions.

The term "albedo" in this context means the ratio of the energy radiation reflected by an object or surface to the energy radiation it receives.

Energy radiation refers to all types of radiation striking the surface of the earth such as radio waves, infrared rays, visible light, ultraviolet rays, X-rays, gamma rays and cosmic rays. The earth will receive most of the energy radiation from the sun in the form of infrared rays, visible light and ultraviolet rays in the form of UVA and UVB rays and this energy radiation is called radiation or light in the patent application, and it is this part of the energy radiation which is measured.

A number of different films and coatings are known for use in agriculture as a covering for surfaces such as fields, in order to obtain special conditions for plant growth. Best known are various types of dark plastic films as covers, in order to obtain higher temperatures in the earth under the film and thereby an increased crop yield.

From US 5 729 929 a plastic film is known for use in agriculture. It is produced from polymer materials such as polyethylene and supplied in specific widths, consisting of longitudinal strips of clear plastic, white or silver-coloured plastic and dark plastic. The film is usually constructed with a longitudinal strip of clear or white plastic in the centre and with strips of dark plastic on both sides. The object of such a film is that the temperature in a furrow or a bed covered by the film should be higher along the edges and lower in the central portion which covers the plants. A temperature difference is thereby obtained between these areas and increased circulation of moisture, thus causing harmful salts to travel to the edges, thereby

preventing weed growth there. The plastic film, however, is not biodegradable and has to be removed manually and replaced every planting season.

In US 4 794 726 a mat is disclosed which is placed on the earth round the stem of plants. The mat consists of fibrous thermoplastic materials which are woven together and supplied in specific widths and lengths. The mat is covered by a layer of aluminium pigments in the form of flakes. The object of the mat is that the aluminium flakes will reflect sunlight on to the underside of the leaves of the plants in order thereby to increase growth and crop yield. The mat does not allow sunlight to pass through and will therefore reduce the temperature variations round the roots of the plants. The mat consists of materials which do not decompose, thus enabling them to be used over several planting seasons.

US 3 775 147 describes a white membrane which can be applied to the earth by spraying. The membrane consists of white pigments, a binder and with water as a solvent. The object of the membrane is to keep the temperature in the earth lower during the germination of plants in order thereby to increase the yield. The patent gives no indication of the possibilities of adjusting a membrane's reflection properties in order to regulate the temperature in the earth under the membrane.

None of the cited patent publications describes the possibility of adjusting the reflection properties of a biodegradable film or membrane. It is therefore an object of the present invention to describe a method and a membrane for use on a solid surface on the earth where the reflection properties of the membrane can be adjusted on the basis of the maximum energy radiation which is conveyed to the ground where the membrane is to be applied. Thus it is possible to adjust the temperature in the membrane and in the surface under the membrane to the desired level. The surface under the membrane will be supplied with moisture in the same ratio as albedo and keep the moisture content at the desired level. In addition, the membrane will adhere to the ground, binding the ground and the soil together. The membrane will also act as a growth medium for vegetation. These objects are achieved by the features which are set forth in the patent claims.

The earth's climate at the present time can be characterised as unstable compared with the climate 40-50 years ago. Hitherto it has been assumed and concluded that the reason for global warming and climatic instability is largely due to the increase in carbon dioxide - CO2 - in the atmosphere. For this reason the emphasis to-day has been on measures in the form of costly taxation of combustion activity in order thereby to attempt to reduce combustion and thereby the discharge of CO2 into the atmosphere.

A study of the development of the CO2 concentration in the atmosphere shows a curve which increases steadily from 1958 until to-day. This is based on measurements, for example, from Mauna Loa, Hawaii, and other measuring stations on earth. According to measurements from Mauna Loa, Hawaii, the concentration of global atmospheric carbon dioxide has increased from 280 ppm in 1958 to 360 ppm in 1999. According to research and measurements the content of man-made CO2 in the atmosphere is between 4% and 5% of total atmospheric CO2.

The provisional conclusion of research in the field is that the temperature increase on earth is due to the increase in CO2 in the atmosphere. The inventors, however, believe that the CO2 increase in the atmosphere is a result of the increase in the temperature in the ground, and that the CO2 content in the atmosphere can be reduced by employing the method and the membrane according to the invention to increase albedo and reduce the temperature in the ground and thereby the CO2 content in the atmosphere. This is one of the advantages of the invention.

The reason for claiming that the process is like that mentioned above is that CO2 is and remains a product of combustion, where carbon and hydrogen with the supply of energy in the form of heat produce CO2. Oxidising combustion with CO2 as a residual product takes place at temperatures above freezing point, and will include nutrient conversion, decomposition and flame activity. The common feature of all oxidising combustion is that CO2 is a fixed part of the end product and a reliable indicator of the intensity of the combustion.

In our solar system the sun is the energy source or radiation source, and the earth is one of several radiation receivers. It is known that the earth intercepts most heat-accumulating energy at the area facing the sun at any

time and that the radiation intensity is highest in the middle of the day when the sun is at its highest point in the sky. The rays which strike the earth supply the surface of the earth with energy, and the majority of the energy is converted to heat in the ground.

It is known that dark areas absorb radiation to a greater extent than light areas. On a scale from white to black it is known that white reflects sunlight best, and a white surface does not become heated to the same extent as a black surface.

Based on the fact that the dark area of the earth's surface was x km2 in 1958 when the CO2 content in the atmosphere was 280 ppm, it is known that the dark area of the earth's surface has increased in step with the CO2 content in the atmosphere. It has been shown that the percentage increase of dark surface on the earth's surface is equal to the percentage increase in CO2 in the atmosphere.

This increase in dark surface on the earth is due primarily to deforestation, drying-up of tracts of land, desertification, expansion of cities and built-up areas and of the network of tarred roads, etc. In 1950 approximately 30% of the earth's land area was covered by tropical forest. In 1975 the area of tropical forest was reduced to 12% and in 1999 the area was further reduced and is now only approximately 7%. It is also known that the area of arable land has been reduced by 7 million hectares per annum.

There has been a steady increase in the earth's percentage of dark surface, which instead of reflecting radiation, will absorb radiation. The temperature in these areas of the earth therefore increases, which in turn leads to an increase in air temperature which is measured locally and globally. In the last 50 years the average global air temperature has increased by approximately 2 degrees C.

The inventors believe that the increase in the air temperature is a result of the increase in dark area on the earth and is not a result of the CO2 content in the atmosphere. By employing the method and using the membrane according to the patent application for covering dark areas, the reflection properties can be regulated and the temperature in dark areas of the earth reduced. This is an advantage of the invention.

In addition, dark areas to which the membrane according to the invention is applied, will be covered with vegetation such as plants and trees. It is known that green areas covered with plants and trees absorb radiation which is used in photosynthesis, with the result that green areas have a temperature-regulating effect. Moreover, plants and trees will employ CO2 in the photosynthesis and an increase in the green area on earth will thereby reduce the CO2 content in the atmosphere.

The invention is primarily intended for use on all kinds of solid surfaces on the earth such as fields and meadows, savannahs, steppes, desert areas, mountains, etc. and included in solid surfaces are surfaces covered by snow and ice.

The rays striking the earth supply the earth's surface with energy and the majority of the energy is converted to heat in the ground. Light is absorbed by green plants and is an energy source for photosynthesis and the biological activity on earth.

With the method and the membrane according to the invention, albedo in the upper layer of a solid surface on the earth can be regulated. This is achieved by adjusting the membrane's content of light-reflecting and/or light-absorbing pigments and/or particles on the basis of the maximum energy radiation conveyed to the upper layer of a solid surface on the earth where the membrane is applied and based on measurements of the local conditions. Thus it is possible to regulate the temperature in the upper layer under the membrane.

By upper layer of a solid surface on the earth we mean primarily the upper layer of the earth's surface from a depth of 0.1 mm to 50 mm depending on the nature of the soil. If, for example, the membrane is laid straight on to rock, the upper layer will be the rock surface.

By using light-reflecting pigments and/or particles in the membrane, the temperature in the upper layer can be reduced. The amount of light-reflecting pigments/particles in the membrane and thereby the membrane's degree of reflection can be adjusted in order to achieve a desired temperature in the membrane and in the upper layer under the membrane. The degree of reflection is adjusted on the basis of measurements of the maximum energy radiation for the local conditions where the membrane is applied.

In the same way, the temperature in the membrane and in the upper layer can be increased by employing light-absorbing pigments and/or particles in the membrane. In areas of the earth with a cool climate, it will be advantageous for the temperature in the membrane and the upper layer under the membrane to be higher than the normal temperature, thus enabling plants to be cultivated over a longer period of the year than normal.

By employing a membrane which neither has light-reflecting nor light-absorbing pigments and/or particles, a transparent membrane is obtained which will retain the natural temperature in the upper layer under the membrane at places on the earth where this is desirable.

The membrane's content of light-reflecting or light-absorbing pigments and/or particles, or the absence of such, is regulated on the basis of the maximum energy radiation which is conveyed to the upper layer of a solid surface on the earth where the membrane is applied and based on measurements of the local conditions. By this means albedo can be regulated. This is one of the advantages of the invention. Albedo will control the temperature in the membrane and in the upper layer and can be regulated in such a manner that the desired and optimal growth conditions are obtained for the vegetation which is natural for any type of earth and any area on earth. This is also one of the advantages of the invention.

Vegetation in this context means all types of plants and trees and non-flowering plants such as bacteria, algae, fungi, lichen, moss, ferns and the like.

In addition the temperature in the upper layer under the membrane can be adjusted in such a manner that vegetation, which is not naturally viable in various geographical areas on earth on account of the temperature, will achieve such viability. This is an additional advantage of the invention.

By maximum energy radiation we mean the highest level of energy radiation from the sun which is conveyed to a surface on earth and can be measured at the maximum solar intensity when the sun is at its highest point in the sky. The energy radiation can be measured by a light meter or by a radiation thermocouple. The energy radiation may, for example, also be measured by measuring the temperature in the upper layer of the surface to which a membrane according to the invention is to be applied. By measuring the

maximum temperature in the course of a day when the surface is sunlit, the maximum energy radiation can be calculated.

On the basis of measurements the reflection properties and the colour of the membrane can be determined based on the maximum temperature which is desirable under the membrane and which will provide optimal growing conditions for the vegetation to be cultivated under the membrane. Measurements have shown that when albedo is reduced by 1% for an upper layer of a solid surface on the earth, the temperature in the upper layer is reduced by 2 degrees C.

As well as reducing albedo by its content of light-reflecting and/or light-absorbing pigments and/or particles, it is desirable for the membrane to have the following properties.

The membrane is formed from a liquid.

The liquid is intended to be sprayed directly on to the ground and may employ known agricultural equipment for this purpose.

After spraying, the liquid sets to form a membrane on contact with air and on evaporation and release of solvent.

The membrane will form a relatively thin coating which adheres to any surface such as earth, sand, stones, rock or the like and will bind this together.

The membrane will have the capacity to absorb and store water.

The membrane may contain seeds and/or spores for vegetation and can bind seeds and/or spores, or release seeds and/or spores to the surface under the membrane.

The membrane will act as a growth medium, supplying seeds and/or spores with the nutrients and moisture required for germination and for the early growth, until the roots have become large enough to penetrate down into and bind together the underlying soil.

It has been found that a liquid according to the invention will set to form a membrane which will have the above-mentioned properties. The liquid consists of a binder of organic adhesives dissolved in a solvent with the

admixture of light-reflecting and/or light-absorbing pigments and/or particles to which are added fibrous organic materials and nutrients and possibly also seeds and/or spores.

As the main components of the liquid, use should be made primarily of to-day's organic waste materials which are easily available and can be supplied at a low price or received free of charge on collection.

The liquid consists primarily of a binder with a high protein content such as animal glue and/or casein glue and/or albumin glue.

Animal glue can be made from animal waste products such as skin, bones and horns of animals, and skin, fins and bones of fish.

Casein glue can be made from milk, milk waste and vegetable proteins.

Albumin glue can be made from blood, blood waste and egg white.

As a solvent water and/or organic liquid is used which is pressed from fruit, berries and plants.

The viscosity of the glue can be regulated by adjusting the amount of solvent added. The solvent content of the glue may vary within wide limits from 50 to 99 volume percentage. The use of a solvent content from 70 to 95 volume percentage will be preferable, and the amount will be dependent on climatic conditions and the surface to which the liquid is applied. The depth of penetration of the liquid into the upper layer of the solid surface is thereby regulated.

In addition to the viscosity, the setting time and mechanical strength of the binder will also be regulated by the admixture of solvent.

By adding materials which modify the protein chains in the glue, so-called softeners, such as ammonium compounds, the elasticity of the membrane can be regulated.

By adding vegetable and/or animal oils to the binder, the membrane's water solubility can be regulated. One or more of the following vegetable and/or animal oils may be used: linseed oil, soya oil, wood oil, coconut oil, fish oil and the like. The membrane's water solubility will to a great extent determine

the membrane's wear life, which may vary within wide limits from a few weeks to several years, but preferably from 6 weeks to 26 weeks.

It has been found that a binder consisting of glue of one of the above-mentioned glue types or a combination of two or more of the above-mentioned glue types makes a very suitable adhesive for all types of surfaces on the earth such as earth, sand, stones, rock, snow, ice or the like and will cover and bind together the ground in the upper layer of a solid surface on the earth. The binder is particularly suitable for use in places where it is normally impossible to obtain a satisfactory vegetation by sowing.

The binder will set to form a membrane on contact with air and on evaporation and/or release of solvent.

As nutrients and growth medium for vegetation and as a reinforcement in the binder, fibrous materials are added cut into specific lengths. As nutrients and fibrous materials, one or more of the following components may be used:

Cellulose fibres from paper recycling, pulp, wood fibre, bark, hemp and the like.

Fibres from all types of textiles such as wool, cotton, viscose, silk, linen and the like.

Plant fibres such as straw, ears of corn, rushes, lichen, moss, peat, roots and the like.

Fibres from dried cow manure, dried manure from cowsheds, dried composted sludge and household waste and the like.

As a reinforcement material use may also be made of glass fibre, rockwool fibre, carbon fibre and similar materials.

The fibrous organic materials will hold and bind moisture in the membrane and may also lead moisture from the surface as precipitation and dew, supplying moisture to seeds and/or spores in the membrane and to the soil in the surface under the membrane. Amongst fibres which have the capacity to hold and release moisture are hollow fibres such as straw, and textile fibres such as wool.

The surface under the membrane will be supplied with moisture from ground water, and tests show that when the membrane's reflection properties increase, the moisture in the surface under the membrane increases proportionately.

A main component in the liquid is light-reflecting and/or light-absorbing materials consisting of one or more of the following pigments and/or particles of finely ground materials.

As light-reflecting materials one or more of the following white or light components may be used:
stones, lime, sand, clay, chalk, shells, etc.
white mineral pigments such as titanium dioxide, etc.
white plant dyes,
white plant fibres such as cotton, bog cotton, etc.

As light-absorbing materials one or more of the following coloured or dark or black components may be used:
ash, coal, carbon black, etc.
earth pigments such as ochre, etc.
bones, shells of animals, shells, fish-scales, etc.
mineral pigments,
plant dyes,
plant pigments, etc.

The liquid's content of binder, solvent and dry material which is the sum of fibrous materials and pigments and possibly additives, may vary within very wide limits and is adjusted on the basis of the temperature in the surface to which the liquid is to be applied and of the nature of the surface, i.e. the particle size of the material in the surface layer and of the surface layer's moisture and absorption capacity. A liquid with a content from 60 to 99 volume percentage binder plus solvent which corresponds to a dry material content from 40 to 1 volume percentage may be used. A liquid with from 70 to 95 volume percentage binder plus solvent will preferably be used where the dry material content will then be from 30 to 5 volume percentage.

The liquid is intended to be sprayed directly on to the surface of the earth, either by hand or by means of available agricultural equipment normally used as manure spreaders or hydroseeders, which are developed with the object of

seeding large vegetation-free areas. The liquid may also be sprayed by airborne equipment such as aircraft, helicopters, etc.

When the liquid is applied by spraying, the liquid volume supplied to each surface unit can easily be measured, thereby enabling the membrane thickness to be regulated. After spraying, the liquid will set to form a membrane on contact with air and sunlight and by the liquid releasing solvent, where some will evaporate and some will be released into the ground.

The thickness of the membrane is adapted to the climate, the nutrient content required and the nature of the ground and may be between 0.1 and 10 mm, preferably between 1 and 5 mm.

The membrane's content of light-reflecting and/or light-absorbing particles and/or pigments is uniformly distributed in the membrane. Thus both the membrane and the upper layer of the surface under the membrane will attain the desired temperature, determined by the amount and properties of the above-mentioned particles/pigments which are adjusted in such a manner that the desired albedo is obtained. Since the membrane's temperature attains the desired and set temperature in all climates, the membrane's wear life will increase due to the fact that decomposition proceeds more slowly. It will thereby be possible to adjust the membrane's wear life more accurately on the basis of the choice of material and the relationship between the components in the membrane. This is also one of the advantages of the invention.

As well as regulating albedo by the adjustment of the content of light-reflecting and/or light-absorbing pigments, the membrane will contain biodegradable organic materials both in the form of a binder and fibrous materials. These organic materials will act as a growth medium for seeds and/or spores for vegetation, such as plants and trees and for non-flowering plants such as bacteria, algae, fungi, lichen, moss, ferns and the like.

The choice of fibrous materials can be adapted to suit the seeds or spores which are incorporated in the membrane in order to provide the best germination and growth conditions for the vegetation to be cultivated in the area concerned. Seeds and/or spores may be incorporated in the membrane and held in the membrane or released from the membrane to the ground.

Seeds and/or spores may also be sown separately on surfaces where the membrane is applied either before or after the membrane is applied.

The nature and type of vegetation will be adapted to suit the climate, the area where the membrane is applied and surface and the nature of the soil. The soil's content of humus and other materials can be measured by standard measuring methods, thus providing an indication of the nutrient content and regulating materials which the membrane has to contain and the amount and thickness of the membrane which it will be necessary to apply on the area concerned. In areas where the soil contains very little humus, it may be necessary to add regulating materials.

As a regulating material there may be incorporated in the membrane nutrient salts of inorganic compounds, so-called chemical fertilisers, such as potassium nitrate, ammonium phosphate, potassium phosphate and the like. There may also be a lack of trace elements, i.e. micronutrients, in the soil, and these must be added in the form of elements such as boron, copper, manganese, molybdenum and the like in order to prevent deficiency diseases in the vegetation. In order to regulate the degree of acidity, formic acid, acetic acid and wood ashes will be suitable additives.

To the liquid may be added a frothing agent such as sulphonates, soap and the like and air or gas by whisking or passing through bubbles just before spraying. By this means a suspension will be formed and the liquid will obtain a creamy consistency, thereby increasing in volume. A volume increase of from 5 to 10 times will be common and thereby the membrane will also become thicker since some of the gas will be trapped in the membrane when it sets. It will be easier to regulate the amount of liquid and the membrane's thickness when a suspension is applied, and in many cases this may be desirable.

When there are gas bubbles trapped in the membrane, the membrane will obtain an uneven and larger surface depending on the size of the gas bubbles, thereby enabling the reflection properties or absorption properties of a membrane to be regulated. This is also an advantage of the invention.

In tests it has been found that both the reflection properties and the absorption properties increase by approximately 5% for a membrane with

trapped gas bubbles compared with a membrane without trapped gas bubbles and with a smooth surface.

Instead of air other gases may be added and whisked or bubbled into the liquid, thus forming a suspension. Amongst the gases which can be employed may be mentioned oxygen, nitrogen, carbon dioxide, ethyne, etc. or a mixture of such gases.

It has been found that by adding one or more gases to the liquid by whisking or bubbling it in to form a suspension, the gas will remain trapped in the membrane and slowly diffuse into the environment, thus making it possible to regulate the germination and growth properties of the seeds or spores which are incorporated in the membrane. In the same way the growth of vegetation which is already sown or is growing under the membrane can be regulated. This is also an advantage of the invention.

Tests have shown that in a membrane with entrapped bubbles of carbon dioxide, the growth and harvest increase by approximately 10% for the plant species cress, Lepidium Satvie, compared to the growth and harvest for the same plant species in a membrane without gas bubbles of carbon dioxide.

It has further been found that by adding ethyne to the liquid by whisking or bubbling it in, thus forming a suspension, the gas will remain trapped in the membrane and slowly diffuse into the layer under the membrane, reducing or killing vegetation under the membrane. A membrane of this kind will prevent the growth of undesirable vegetation such as weeds and may be used in areas where this is desirable.

Tests have been carried out in propagating tubs illuminated by artificial sunlight. As a light source, light tubes were employed which also emitted UVA and UVB rays.

The propagating tubs were 250 mm wide, 600 mm long and 60 mm deep. The propagating tubs were filled with a 50 mm thick layer of fertilised and moistened earth, and in each propagating tub there were sown 2g of seed of the cress plant, Lepidium Satvie.

To the surface of the earth in each propagating tub was applied a membrane according to the invention. In each tub the membrane had different contents of a type of light-reflecting pigments, from 0% in tub 5 to 80% in tub 1. The

tests took place over a period of 18 days, and during the period of the test no liquid, fertilizer or other elements were added to the earth in the propagating tubs. During the entire test period the air temperature was 16 degrees C.

The table below shows the results of measurements carried out in the propagating tubs and of the plant yield.

Tub no.	1	2	3	4	5
Light-reflecting pigments in %	80	60	40	20	0
Earth temperature in degrees C	16.1	16.8	17.5	18.2	18.7
Electrical resistance in earth in M ohm/cm	0.005	0.007	0,01	0.014	0.02
Cress plants: Germination time in hours	56	52	45	39	31
Height in mm after 18 days	37	43	47	52	58
Weight of yield in g after 18 days	8.4	11.2	19.4	21.1	27.9

The tests show that the temperature in the earth under the membrane drops linearly with increasing content of light-reflecting pigments in the membrane.

The electrical resistance in the earth was measured, and is a measure of the moisture in the earth, with the highest resistance showing the lowest moisture in the earth, i.e. the driest earth.

The tests show that the moisture in the earth increases with an increasing content of light-reflecting pigments in the membrane.

The tests on germination and growth of the cress plants show that it is essential that the temperature in the earth should be regulated to the correct level for the plant species used.

The germination time for the plants was reduced by approximately 50% when the temperature in the earth under the membrane increased by 2.6 degrees C.

The weight of the crop after 18 days increased by more then 200% when the temperature in the earth increased by the same 2.6 degrees C.

PATENT CLAIMS

1. A method for regulating albedo in an upper layer of a solid surface on the earth in order to influence thermal and biological factors such as surface temperature and cultivation properties, characterized in that to the surface is applied a liquid which sets to form a biodegradable membrane and that the membrane's content of light-reflecting and/or light-absorbing particles/pigments is adjusted on the basis of the maximum energy radiation which is conveyed to an upper layer of a solid surface on the earth based on measurements of the local conditions.

2. A method according to claim 1, characterized in that the membrane's reflection properties and/or transmission properties and/or absorption properties are adjusted on the basis of the maximum energy radiation which is conveyed to the upper layer of the solid surface on the earth in order to regulate the temperature in the upper layer of the solid surface under the membrane.

3. A method according to claims 1 and 2, characterized in that the membrane's reflection properties and/or transmission properties and/or absorption properties are adjusted on the basis of the maximum energy radiation which is conveyed to the upper layer of the solid surface on the earth in order to regulate the moisture in the upper layer of the solid surface under the membrane.

4. A method according to one of the preceding claims, characterized in that the membrane's permeability is adjusted by supplying fibrous materials in order to regulate the diffusion properties of the membrane and thereby regulate diffusion of gases and water vapour to and from the upper layer of the solid surface under the membrane.

5. A method according to one of the preceding claims, characterized in that the liquid's viscosity is adjusted by supplying solvent on the basis of particle size and particle density in an upper layer of a solid surface on the earth in order to regulate the liquid's depth of penetration into the upper layer of the solid surface, thereby regulating the mechanical binding of the membrane to the upper layer.

6. A method according to one of the preceding claims, characterized in that the liquid's content of nutrients is adjusted by supplying fibrous materials on the basis of an analysis of the nutrient content of the upper layer of the solid surface on the earth in order thereby to regulate the supply of nutrients to the upper layer.

7. A method according to one of the preceding claims, characterized in that the liquid's content of acid and/or basic materials is adjusted on the basis of the degree of acidity measured in the upper layer of the solid surface on the earth in order thereby to regulate the degree of acidity in the upper layer.

8. A method according to one of the preceding claims, characterized in that the membrane's elasticity is regulated by adjusting the amount of softener added to the binder in order to regulate the membrane's mechanical properties.

9. A method according to one of the preceding claims, characterized in that the membrane's water solubility is regulated by adjusting the amount of animal and/or vegetable oil added to the binder in order to regulate the membrane's wear life.

10. A method according to one of the preceding claims, characterized in that the liquid's viscosity and content of seeds and/or spores is adjusted in order to regulate the membrane's content of seeds and/or spores and in order to regulate the release of seeds and/or spores to the upper layer of the solid surface before the liquid sets to form a membrane.

11. A method according to one of the preceding claims, characterized in that one or more gases are whisked into the liquid or added as bubbles to form a suspension in order thereby to regulate the surface area of the membrane, thereby regulating the membrane's reflection properties and/or absorption properties.

12. A method according to one of the preceding claims, characterized in that the one or more gases are whisked into the liquid or added as bubbles to form a suspension in order thereby to regulate the growth properties of seeds and/or spores which are incorporated in the membrane

and/or the growth properties of seeds and/or spores and/or vegetation in the surface under the membrane.

13. A biodegradable membrane for regulating albedo in order to influence thermal and biological factors for use on an upper layer of a solid surface on the earth,
characterized in that the membrane is composed of a liquid which sets on contact with air and on evaporation of solvent when it is applied to an upper layer of a solid surface on the earth and that the liquid comprises the following main components:

a) a binding agent consisting of proteins, preferably as one or more of the following components: animal glue made of animal waste products and/or casein glue made of milk waste and vegetable proteins and/or albumin glue made of blood waste,

b) a fibrous material/reinforcement/nutrients cut into specific lengths preferably as one or more of the following components: cellulose fibre from paper recycling, pulp, wood fibre, bark, etc. and/or textile fibre and/or plant fibre such as straw, ears of corn, rushes, lichen, moss, peat, etc. and/or manure from cowsheds, dried cow manure, dried composted sludge and household waste, etc.

c) a solvent consisting of water and/or organic liquid from pressed fruit, berries and/or plants,

d) a light-reflecting material consisting of pigments/particles, preferably consisting of one or more of the following materials: white lime, white sand, white stones, white clay, chalk, white shells and/or white mineral pigments and/or white plant dyes and/or white plant fibres such as cotton, bog cotton, etc.

e) a light-absorbing material consisting of the following coloured and/or dark and/or black pigments/particles, preferably one or more of the following materials: ash, coal, and/or earth pigments such as ochre, etc. and/or mineral pigments and/or pigments of shells of animals, bones, etc. and/or plant dyes, plant pigments, etc.

f) additives such as animal and/or vegetable oil,

g) additives such as ammonium compound,

h) possibly additives consisting of a biodegradable foaming agent such as sulphonate, soap, etc.

i) possibly additives for regulating the degree of acidity such as acetic acid, formic acid, wood ashes, etc.

where the composition in % is determined by the properties desired in the upper layer where the liquid is applied and by the maximum energy radiation which is conveyed to the surface of the upper layer based on measurements of the local conditions.

14. A biodegradable membrane according to claim 13, characterized in that in the membrane there are incorporated nutrient salts of another kind such as chemical fertilizer and/or trace elements.

15. A biodegradable membrane according to claims 13 and 14, characterized in that in the membrane there are incorporated seeds and/or spores for vegetation such as plants and trees and/or non-flowering plants such as bacteria, algae, fungi, lichen, moss, ferns and the like.

16. A biodegradable membrane according to claims 13, 14, 15, characterized in that in the membrane there are incorporated one or more gases by means of whisking and/or passing through bubbles, thus forming a suspension.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 01/00127

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A01G 13/02 // A01G 1/00, A01G 13/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6029395 A (MORGAN), 29 February 2000 (29.02.00), column 5, line 1 - line 11; column 3, line 45 - line 46, claim 1, abstract	1-16
	--	
X	EP 0177226 A3 (POLYSAR LIMITED), 9 April 1986 (09.04.86), page 11, line 28 - page 12, line 34; page 21, line 25 - line 30, abstract	1-12
A		13-16
	--	
A	WO 9801510 A1 (STATE OF ISRAEL/MINISTRY OF AGRICULTURE), 15 January 1998 (15.01.98), abstract	1-16
	--	

[X] Further documents are listed in the continuation of Box C.   [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 July 2001	18 -07- 2001
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ingrid Falk/EK Telephone No. +46 8 782 25 00

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3891571 A (LAMBOU ET AL), 24 June 1975 (24.06.75), abstract -- --------	1-16

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/07/01

International application No.
PCT/NO 01/00127

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US	6029395	A	29/02/00	NONE			
EP	0177226	A3	09/04/86	SE	0177226	T3	
				CA	1266992	A	27/03/90
				DE	3585764	A	07/05/92
				EG	17432	A	30/06/89
				ES	547118	A	16/11/87
				ES	8800577	A	01/02/88
				FI	83229	B,C	28/02/91
				FI	853507	A	21/03/86
				IL	76390	A	18/01/90
				JP	61074523	A	16/04/86
				NO	164106	B,C	21/05/90
				NO	853631	A	21/03/86
				US	4705816	A	10/11/87
WO	9801510	A1	15/01/98	AU	711147	B	07/10/99
				AU	3271597	A	02/02/98
				CA	2259236	A	15/01/98
				CN	1065264	B	02/05/01
				CN	1224441	A	28/07/99
				EP	0909300	A	21/04/99
				IL	118787	A	17/02/00
				US	2001001634	A	24/05/01
US	3891571	A	24/06/75	NONE			